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PTO/SB/05 (4/98)
Approved for use through 09/30/2000 OMB 0651-0032
Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 C.F.R. § 1.53(b))

Attorney Docket No.	MI22-1550
First Inventor or Application Identifier	Jason E. Tripard
Title	Integrated Circuit Package Separators
Express Mail Label No.	EL465688995US

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

ADDRESS TO: **Assistant Commissioner for Patents, Box Patent Application, Washington, DC 20231**

1. [X] * Fee Transmittal Form *(e.g., PTO/SB/17)* *(Submit an original and a duplicate for fee processing)*
2. [X] Specification [*Total Pages* 44] *(preferred arrangement set forth below)*
   - Descriptive title of the Invention
   - Cross References to Related Applications
   - Statement Regarding Fed sponsored R & D
   - Reference to Microfiche Appendix
   - Background of the Invention
   - Brief Summary of the Invention
   - Brief Description of the Drawings *(if filed)*
   - Detailed Description
   - Claim(s)
   - Abstract of the Disclosure
3. [X] Drawing(s) *(35 U.S.C. 113)* [*Total Sheets* 6]
4. Oath or Declaration [*Total Pages* 2]
   a. [ ] Newly executed (original or copy)
   b. [X] Copy from a prior application (37 C.F.R. § 1.63(d)) *(for continuation/divisional with Box 16 completed)*
      i. [ ] DELETION OF INVENTOR(S) Signed statement attached deleting inventor(s) named in the prior application, see 37 C.F.R. §§ 1.63(d)(2) and 1.33(b).

NOTE FOR ITEMS 1 & 13 IN ORDER TO BE ENTITLED TO PAY SMALL ENTITY FEES, A SMALL ENTITY STATEMENT IS REQUIRED (37 C.F.R. § 1.27), EXCEPT IF ONE FILED IN A PRIOR APPLICATION IS RELIED UPON (37 C.F.R. § 1.28).

5. [ ] Microfiche Computer Program *(Appendix)*
6. Nucleotide and/or Amino Acid Sequence Submission *(if applicable, all necessary)*
   a. [ ] Computer Readable Copy
   b. [ ] Paper Copy (identical to computer copy)
   c. [ ] Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

7. [ ] Assignment Papers (cover sheet & document(s))
8. [ ] 37 C.F.R.§3.73(b) Statement *(when there is an assignee)* [ ] Power of Attorney
9. [ ] English Translation Document *(if applicable)*
10. [X] Information Disclosure Statement (IDS)/PTO-1449 [ ] Copies of IDS Citations
11. [X] Preliminary Amendment
12. [ ] Return Receipt Postcard (MPEP 503) *(Should be specifically itemized)*
13. [ ] * Small Entity Statement(s) *(PTO/SB/09-12)* [ ] Statement filed in prior application Status still proper and desired
14. [ ] Certified Copy of Priority Document(s) *(if foreign priority is claimed)*
15. [ ] Other: .....

16. **If a CONTINUING APPLICATION,** *check appropriate box, and supply the requisite information below and in a preliminary amendment:*

[ ] Continuation [X] Divisional [ ] Continuation-in-part (CIP) of prior application No. 09/533,058

Prior application information: *Examiner* S. Choi *Group / Art Unit.* 3724

For CONTINUATION or DIVISIONAL APPS only: The entire disclosure of the prior application, from which an oath or declaration is supplied under Box 4b, is considered a part of the disclosure of the accompanying continuation or divisional application and is hereby incorporated by reference. The incorporation can only be relied upon when a portion has been inadvertently omitted from the submitted application parts.

17. CORRESPONDENCE ADDRESS

[X] *Customer Number or Bar Code Label* 021567 *(Insert Customer No. or Attach bar code label here)* *or* [ ] *Correspondence address below*

Name	Wells, St. John, Roberts, Gregory & Matkin, P.S.				
Address	601 W. First Avenue, Suite 1300				
City	Spokane	*State*	WA	*Zip Code*	99201-3828
Country		*Telephone*		*Fax*	

Name (Print/Type)	D. Brent Kenady	*Registration No (Attorney/Agent)*	40,045
Signature		*Date*	10-12-00

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TOTAL AMOUNT OF PAYMENT	($) 710.00

Complete if Known	
Application Number	Priority 09/533,058
Filing Date	Priority March 22, 2000
First Named Inventor	Jason E. Tripard
Examiner Name	Priority S. Choi
Group / Art Unit	Priority 3724
Attorney Docket No.	MI22-1550

METHOD OF PAYMENT (check one)

1. [X] The Commissioner is hereby authorized to charge indicated fees and credit any over payments to:

Deposit Account Number: 23-0925
Deposit Account Name: Wells, St. John et al.

[X] Charge Any Additional Fee Required Under 37 CFR 1.16 and 1.17

2. [X] **Payment Enclosed:** [X] Check [ ] Money Order [ ] Other

FEE CALCULATION

1. BASIC FILING FEE

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
101	760	201	380	Utility filing fee	710.00
106	310	206	155	Design filing fee	
107	480	207	240	Plant filing fee	
108	760	208	380	Reissue filing fee	
114	150	214	75	Provisional filing fee	

SUBTOTAL (1) ($) 710.00

2. EXTRA CLAIM FEES

		Extra Claims		Fee from below	Fee Paid
Total Claims	13	-20** = 0	X	18.00	=
Independent Claims	1	-3** = 0	X	80.00	=
Multiple Dependent					= 0.00

**or number previously paid, if greater, For Reissues, see below

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description
103	18	203	9	Claims in excess of 20
102	78	202	39	Independent claims in excess of 3
104	260	204	130	Multiple dependent claim, if not paid
109	78	209	39	** Reissue indenpendent claims over original patent
110	18	210	9	** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) ($) 0.00

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
105	130	205	65	Surcharge - late filing fee or oath	0.00
127	50	227	25	Surcharge - late provisional filing fee or cover sheet.	0.00
139	130	139	130	Non-English specification	0.00
147	2,520	147	2,520	For filing a request for reexamination	0.00
112	920*	112	920*	Requesting publication of SIR prior to Examiner action	0.00
113	1,840*	113	1,840*	Requesting publication of SIR after Examiner action	0.00
115	110	215	55	Extension for reply within first month	0.00
116	380	216	190	Extension for reply within second month	0.00
117	870	217	435	Extension for reply within third month	0.00
118	1,360	218	680	Extension for reply within fourth month	0.00
128	1,850	228	925	Extension for reply within fifth month	0.00
119	300	219	150	Notice of Appeal	0.00
120	300	220	150	Filing a brief in support of an appeal	0.00
121	260	221	130	Request for oral hearing	0.00
138	1,510	138	1,510	Petition to institute a public use proceeding	0.00
140	110	240	55	Petition to revive - unavoidable	0.00
141	1,210	241	605	Petition to revive - unintentional	0.00
142	1,210	242	605	Utility issue fee (or reissue)	0.00
143	430	243	215	Design issue fee	0.00
144	580	244	290	Plant issue fee	0.00
122	130	122	130	Petitions to the Commissioner	0.00
123	50	123	50	Petitions related to provisional applications	0.00
126	240	126	240	Submission of Information Disclosure Stmt	0.00
581	40	581	40	Recording each patent assignment per property (times number of properties)	0.00
146	760	246	380	Filing a submission after final rejection (37 CFR 1.129(a))	0.00
149	760	249	380	For each additional invention to be examined (37 CFR 1.129(b))	0.00
				Other fee (specify) _____	0.00
				Other fee (specify) _____	0.00

*Reduced by Basic Filing Fee Paid

SUBTOTAL (3) ($) 0.00

SUBMITTED BY				Complete (if applicable)	
Typed or Printed Name	D. Brent Kenady			Reg. Number	40,045
Signature		Date	10-12-00	Deposit Account User ID	

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EL465688995

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Priority Application Serial No. 09/533,058
Priority Filing Date ..... March 22, 2000
Inventor ..... Jason E. Tripard
Assignee ..... Micron Technology, Inc.
Priority Group Art Unit 3724
Priority Examiner ..... S. Choi
Attorney's Docket No. MI22-1550
Title: Integrated Circuit Package Separators

PRELIMINARY AMENDMENT

To: Assistant Commissioner for Patents
Washington, D.C. 20231

From: D. Brent Kenady (Tel. 509-624-4276; Fax 509-838-3424)
Wells, St. John, Roberts, Gregory & Matkin P.S.
601 W. First Avenue, Suite 1300
Spokane, WA 99201-3828

Date of Deposit: 06/08/01

AMENDMENTS

In the Specification

Replace the title with --Integrated Circuit Package Separators--.

At p. 1, before the "Technical Field" section, insert --RELATED PATENT DATA

This patent resulted from a divisional application of United States Patent Application Serial No. 09/533,058, filed March 22, 2000, and titled "Integrated Circuit Package Separators", which is a divisional application

of United States Patent Application Serial No. 09/176,479, which was filed on October 20, 1998.--

Amended Claims

Please cancel claims 1-21 and 35-91.

REMARKS

Claims 1-21 and 35-91 are canceled, leaving claims 22-34 pending in the application. Applicant elects to prosecute the claims of Group E and requests examination of such claims.

Respectfully submitted,

Dated: 10-12-00

By: D. Brent Kenady

D. Brent Kenady
Reg. No. 40,045

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EL169835515

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICATION FOR LETTERS PATENT

* * * * *

Integrated Circuit Package Separators, And Methods Of Forming Integrated Circuit Packages

* * * * *

INVENTORS

Jason E. Tripard

ATTORNEY'S DOCKET NO. MI22-975

EXPRESS MAIL CERTIFICATE

Integrated Circuit Package Separators, And Methods Of Forming Integrated Circuit Packages

TECHNICAL FIELD

The invention pertains to methods of forming integrated circuit packages, as well as to devices for separating integrated circuit packages.

BACKGROUND OF THE INVENTION

Circuit constructions having integrated circuit (IC) chips bonded to circuit boards (such as SIMMs and DIMMs) can be fabricated by joining IC chips on a single large circuit board comprising a plurality of the constructions. The circuit board can be subsequently cut to separate discrete constructions from one another. The discrete constructions are referred to herein as integrated circuit packages. The smaller the individual circuit packages, the more likely it is for industry processing to utilize the above-described method of forming the packages on a single large board and subsequently cutting individual packages from the board.

An exemplary prior art process of separating integrated circuit packages is described with reference to Fig. 1. Fig. 1 illustrates a board assembly 10 having a plurality of IC chips 12 (only some of which are labeled) bonded thereto. Chips 12 are aligned into individual IC package configurations 14 (only some of which are labeled) to form a repeating pattern of integrated circuit packages 14 across the board

assembly 10. Dashed lines 16 are shown to illustrate the boundaries between individual IC packages 14. In the shown exemplary embodiment, assembly 10 comprises three separate circuit boards 11, 13 and 15. The number and size of individual circuit boards can vary depending on the number and size of IC packages that are ultimately to be formed.

Each of boards 11, 13 and 15 comprises a pair of lateral waste sections 21, 23 and 25, respectively. The lateral waste sections 21, 23 and 25 are separated from the remainder of boards 11, 13 and 15, respectively, by imaginary dashed lines 20, 22 and 24. In further processing, the individual IC packages 14 are separated from one another by cutting through boards 11, 13 and 15 along the regions illustrated by dashed lines 16. During the cutting to separate IC packages 14 from one another, boards 11, 13 and 15 are also cut along regions illustrated by dashed lines 20, 22 and 24 to remove waste portions 21, 23 and 25 from the lateral sides of the boards, and accordingly from lateral edges of the ultimately formed IC packages.

Orifices 19 (only some of which are labeled) are provided throughout circuit boards 11, 13 and 15. Specifically, pairs of orifices 19 are provided in each IC package 14, and at least two orifices 19 are provided in each of waste portions 21, 23 and 25.

Fig. 1 further illustrates an IC package separator 40 comprising a cutting mechanism 42 (shown schematically as a cutting wheel, although other cutting mechanisms, such as, for example, router bits or linear

blades, are known to persons of ordinary skill in the art), a retaining table 44, and a control mechanism 45 configured to control orientation of cutting wheel 42 relative to table 44. Retaining table 44 can comprise, for example, an *x-y* table (*i.e.*, a table horizontally adjustable in *x* and *y* directions; an "X", "Y" and "Z" axis system is illustrate in a lower corner of Fig. 1). Control mechanism 45 can control the *x* and *y* orientation of table 44 and the *z* (i.e., vertical) orientation of cutting mechanism 42 to precisely cut a board retained on table 44. Table 44, cutting mechanism 42, and control mechanism 45 can be comprised by commercially available cutting systems, such as, for example, Advanced Technology Incorporated's CM101 single spindle router (or, more generally, a circuit board depanelization router).

Fig. 1 also illustrates that table 44 comprises an upper platform 46. A subplate 48 is provided over platform 46, and a stripper plate 50 is provided over subplate 48. Subplate 48 comprises a plurality of upwardly extending pins 60 (only some of which are labeled), and stripper plate 50 comprises a number of orifices 62 configured to slide over pins 60. Subplate 48 is retained on table 44 by downwardly extending pins (not shown) which are aligned with and precisely received within orifices (not shown) extending within platform 46 of table 44.

Orifices 19 of boards 11, 13 and 15 align with pins 60. In operation, boards 11, 13 and 15 are slid over pins 60 until the pins protrude through orifices 19. Typically, orifices 19 are only about

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0.003 inches wider than pins 60 to insure tight alignment of boards 11, 13 and 15 with subplate 48. After boards 11, 13 and 15 are retained on table 44 by pins 60, cutting mechanism 42 is utilized to cut along the regions illustrated by dashed lines 16, 20, 22 and 24. Such cutting separates discrete integrated circuit packages 14 from one another, as well as from waste regions 21, 23 and 25. The separated circuit packages are retained on table 44 by pins 60 extending through the packages. Specifically, each of individual packages 14 comprises a pair of orifices 19 and is thereby retained on table 44 by a pair of pins 60.

After the IC packages are separated from one another, stripper plate 50 is manually lifted off of subplate 42 to lift the IC packages 14 from pins 60. Once stripper plate 50 is lifted off from pins 60, the individual IC packages can be separated from stripper plate 50. An exemplary method of removing the IC packages from stripper plate 50 is to tilt plate 50 and allow the packages to slide off plate 50. After the packages 14 are removed, plate 50 can be returned to over 48 and used again for separating IC packages.

Difficulties can occur in utilizing the assembly of Fig. 1 for separating IC packages. For instance, separated IC packages can be broken as stripper plate 50 is lifted from subplate 48. It would be desirable to reduce or eliminate such problems.

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SUMMARY OF THE INVENTION

In one aspect, the invention encompasses a method of forming integrated circuit packages. A base having a plurality of pins extending upwardly therefrom is provided. A support is provided over the base. The support has an upper surface and a plurality of holes extending therethrough. The pins extend through the holes and upwardly beyond the upper surface of the support. An actuator is provided beneath the support. A board having a plurality of integrated circuits bonded thereto is provided. The integrated circuits form a repeating pattern of integrated circuit packages across the board, and the board has a plurality of holes extending through it. The board is placed over the support upper surface with the pins extending into the holes in the board. While the board is over the support upper surface, it is cut to separate the integrated circuit packages from one another. After the cutting, the support is vertically displaced by the actuator to lift the support off the pins.

In another aspect, the invention encompasses an integrated circuit package separator for separating integrated circuit packages from a board. The board comprises a plurality of integrated circuits bonded thereto, and has a plurality of holes extending within it. The separator includes a base having a plurality of pins extending upwardly therefrom and a support over the base. The support has an upper surface, a plurality of holes extending therethrough, and a pair of opposing ends. The pins

extend through the holes in the support and upwardly beyond the upper surface of the support. The support and pins are configured such that the pins extend into the holes in the board when the board is placed over the support upper planar surface. The separator further includes a pair of actuators beneath the support and configured to vertically displace the support and lift the support off the pins. Additionally, the separator includes a cutting mechanism configured to cut the board while the board is over the support upper planar surface and thereby separate the integrated circuit packages from one another.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the invention are described below with reference to the following accompanying drawings.

Fig. 1 is a diagrammatic, perspective, exploded view of a prior art IC package separator and circuit board assembly.

Fig. 2 is a diagrammatic top view of an IC package separator of the present invention.

Fig. 3 is a diagrammatic, perspective, exploded view of an IC package separator of the present invention with a stripper plate of the present invention and a circuit board.

Fig. 4 is a view of the Fig. 3 assembly with the circuit board retained on the IC separator.

Fig. 5 is a view of the Fig. 4 assembly after the retained circuit board is cut to separate individual IC packages from one another.

Fig. 6 is a view of the Fig. 5 assembly after a stripper plate is lifted to release separated IC packages from retaining pins.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

This disclosure of the invention is submitted in furtherance of the constitutional purposes of the U.S. Patent Laws "to promote the progress of science and useful arts" (Article 1, Section 8).

An IC package separator of the present invention and a method of operation of such separator are described below with reference to Figs. 2-6. In referring to Figs. 2-6, similar numbering to that utilized above in describing prior art Fig. 1 will be used, with differences indicated by the suffix “a” or by different numerals.

Referring to Fig. 2, a separator 100 of the present invention is shown in top view. Separator 100 comprises a table 44a and a subplate 48a provided over table 44a. Table 44a can comprise, for example, an *x-y* table similar to the table 44 described above with reference to Fig. 1. Subplate 48a, like the above-described substrate 48 of Fig. 1, can be joined to table 44a through a plurality of downwardly extending pins (not shown), and comprises a plurality of upwardly extending pins 60 (only some of which are labeled) configured to retain a circuit board assembly (not shown).

Subplate 48a differs from subplate 48 of Fig. 1 in that subplate 48a comprises notches 102 at its ends. Notches 102 are provided to allow room for a pair of forcer plates 104 and 106 to move vertically (in and out of the page of Fig. 2) relative to table 48a. Forcer plates 104 and 106 comprise upwardly extending pins 108 and 110, respectively. Base plate 48a comprises an upper planar surface 115, and forcer plates 104 and 106 comprise upper planar surfaces 117 and 119, respectively. Upper planar surfaces 115, 117 and 119 ultimately support a circuit board assembly (not shown in Fig. 2). Planar surfaces 115, 117 and 119 are preferably substantially coplanar with one another to avoid distorting (e.g., bending) a supported circuit board assembly.

Forcer plates 104 and 106 are connected to actuators 112 and 114, respectively, configured to vertically displace forcer plates 104 and 106. In the exemplary shown embodiment, forcer plates 104 and 106 are connected to the actuators with screws 116. It is to be understood, however, that other mechanisms could be utilized for joining forcer plates 104 and 106 to actuators 112 and 114, including, for example, welding.

Actuators 112 and 114 are pneumatic (preferably air-powered) and connected to a gas source 120. An advantage of utilizing air powered actuators is that most wafer fabrication plants have a source of clean dry air available. Accordingly, it is relatively convenient to couple air

powered actuators 112 and 114 into existing fabrication plants by simply connecting them to existing air lines. However, it is to be understood that the actuators can be powered by other sources besides air, including, for example, other fluids, such as liquids, as well as non-pneumatic and non-hydraulic sources, such as, for example, electricity.

Separator apparatus 100 comprises a cutting assembly (not shown in Fig. 2) and a controller (not shown in Fig. 2), analogous to the cutting assembly 42 and controller 45 of Fig. 1.

Referring to Fig. 3, IC circuit package separator 100 is shown in exploded view with a circuit board assembly 10 identical to the assembly described above with reference to Fig. 1.

A stripper plate 50a is provided between subplate 48a and circuit board assembly 10. Stripper plate 50a is similar to the stripper plate 50 of Fig. 1 in that plate 50a comprises a plurality of orifices 62 configured for receipt of pins 60. However, stripper plate 50a differs from plate 50 of Fig. 1 in that plate 50a also comprises orifices 122 configured for receipt of upwardly extending pins 108 and 110 of forcer plates 104 and 106. Pins 108 and 110 are preferably tapered pins, such as can be obtained from McMaster-Carr. Exemplary pins have a dimension of 0.248 inches at base, 0.2324 inches at top, and a length of 0.75 inches. The taper of the pins can assist in aligning support 50a over the pins during placement of support 50a onto base 48a.

Stripper plate 50a further differs from plate 50 of Fig. 1 in that plate 50a is configured for receipt of a series of panels 132, 134 and 136. Stripper plate 50a can comprise, for example, static-reduced plastic having a thickness of greater than 3/16 inches, and panels 132, 134 and 136 can comprise, for example, aluminum. In the shown embodiment, panels 132, 134 and 136 are held to stripper plate 50a by a plurality of screws 138 (only some of which are labeled). It will be recognized, however, that other mechanisms can be utilized for holding panels 132, 134 and 136 to stripper plate 50a, including riveting. Alternatively, panels 132, 134 and 136 can be molded as part of stripper plate 50a.

Panels 132, 134 and 136 comprise ribs 140, 142 and 144, respectively (only some of which are labeled). Ribs 140, 142 and 144 can assist in supporting board assembly 10. Specifically, IC chips 12 are frequently provided on both an upper surface of circuit board assembly 10, and a bottom surface (not shown). Ribs 140, 142 and 144 (also referred to as blocks) have upper surfaces 141, 143 and 145, respectively, which contact the bottom surfaces of circuit boards 11, 13 and 15 at locations between the IC chips 12 on the bottom of the board. Preferably, such upper surfaces are provided at a height approximately equal to a thickness of integrated circuit chip components 12. Accordingly, when boards 11, 13 and 15 are rested on panels 132, 134 and 136, respectively, the boards rest on the upper

surfaces of blocks 140, 142 and 144 while leaving integrated circuit chip components on the underside of boards 11, 13 and 15 extending between block upper surfaces 141, 143 and 145 and panels 132, 134 and 136. An exemplary block height (or thickness) of blocks 140, 142 and 144 for a DRAM having IC chips 12 with a TS0P dimensional package is 0.040 inches ±0.005 inches. As another example, if IC chips 12 have a S0J dimensional package, the block height is preferably 0.140 inches ±0.005 inches.

Blocks 140, 142 and 144 can be formed as one piece with panels 132, 134 and 136. Alternatively, blocks 140, 142 and 144 can be formed as discrete pieces from panels 132, 134 and 136 that are subsequently fastened to the panels.

In the shown embodiment, blocks 140, 142 and 144 are provided in a one-to-one correspondence with integrated chip packages 14. Also, in the shown exemplary embodiment each of panels 132, 134 and 136 is identical to one another, and in a one-to-one correspondence with individual boards 11, 13 and 15. It is to be understood, however, that the invention encompasses other embodiments (not shown) wherein the blocks are not provided in a one-to-one correspondence with packages 14, wherein the panels are not identical to one another, and wherein the panels are not in a one-to-one correspondence with the individual boards.

PATENT APPLICATION

Pins 60 extend upwardly beyond upper surfaces 141, 143 and 145 of blocks 140, 142 and 144, and are configured to retain circuit board assembly 10 over stripper panel 50a. In the shown embodiment, pins 60 do not extend through panels 132, 134 and 136. However, it is to be understood that the invention encompasses other embodiments wherein pins 60 do extend through such panels.

Fig. 3 shows a side perspective view of actuator 112. In such view it can be seen that several ports 150, 152, 153, 154. 155 and 156 are provided between actuator 112 and gas source 120. Valves (not shown) are provided between source 120 and one or more of ports 150, 152, 153, 154, 155 and 156. Such valves enable fluid to be selectively flowed from source 120 into one or more of ports 150, 152, 153, 154, 155 and 156 to selectively control raising and lowering of forcer plate 104 with actuator 112. For instance, flow of gas into port 152 can force a pneumatic cylinder to lift forcer plate 104, and flow of gas into port 150 can force the pneumatic cylinder to lower forcer plate 104.

Ports 154 and 156 are connected to release valves 163 and 165, respectively, which enable a pressure on at least one side of the pneumatic cylinder of actuator 112 to be maintained at ambient pressure (generally, about 1 atmosphere). Specifically, release valves 163 and 165 comprise outlet ports 157 and 159, respectively, which vent to a surrounding environment. Persons of ordinary skill in the art will recognize that one or more of ports 150, 157 and 159 are utilized as gas

outlet ports during lifting of forcer plate 104, and port 152 comprises a gas inlet port during such lifting. In preferred embodiments of the present invention, the release valves are associated with an outlet side of actuator 112 to enable equilibration of a pressure at such outlet side to ambient prior to (and/or during) lifting of forcer plate 104. Specifically, the release valves enable gas to be drained from outlet lines (more specifically, the gas is drained through ports 157 and 159 which are open to ambient conditions) prior to, and/or during, lifting with the actuator. Actuator 114 (Fig. 2) is preferably identical to actuator 112 and connected to an identical valve and port assembly as that shown connected to actuator 112. Accordingly, actuator 114 is also connected with release valves configured to equilibrate a back-pressure of the actuator to ambient prior to, and/or during, lifting of stripper panel 50a. The equilibration of pressure at the outlet ends of both of actuators 112 and 114 to ambient during a lifting operation can enable both actuators to have an identical back-pressure during the lifting operation. This can facilitate having both actuators lift simultaneously and in unison. Such simultaneous lifting can avoid distortion (such as, for example, bending) of circuit board assembly 10 during the lifting.

Stripper plate 50a has an upper planar surface 160 and a pair of opposing ends 162 and 164. Opposing ends 162 and 164 overlie forcer plates 104 and 106, respectively. In operation, actuators 112 and 114 are utilized to lift opposing ends 162 and 164 simultaneously and in

unison. Such can be accomplished by, for example, maintaining approximately equal gas pressure at both of actuators 112 and 114 during lifting, and is found to reduce breakage of integrated circuit packages relative to prior art methods. The term "approximately" in the previous sentence is utilized to indicate the gas pressure at both actuators is equal within operational parameters.

A method of operation of separator 100 is described with reference to Figs. 4-6. In referring to Figs. 4-6, subplate 48a is referred to as a base, and stripper plate 50a is referred to as a support. Referring first to Fig. 4, circuit board assembly 10 is shown retained on support 50a. Specifically, circuit board assembly 10 is placed over support upper surface 160 with pins 60 extending through orifices 19 of the circuit boards 11, 13 and 15. Pins 60 and board assembly 10 are aligned such that each of the integrated circuit packages 14 is retained to the support 50a by at least one pin, and, in the shown embodiment, is retained by 2 pins. In the Fig. 4 processing step, actuators 112 and 114 (Fig. 2) are in a lowered position.

Referring to Fig. 5, the individual integrated circuit packages 14 are separated from one another by cutting through boards 11, 13 and 15.

Referring to Fig. 6, actuators 112 and 114 (Fig. 2) are utilized to vertically displace support 50a from base 48a. Preferably, such vertical displacement comprises lifting both of ends 162 and 164 of support 50a substantially simultaneously and substantially in unison with one another.

(As used in the preceding sentence, the term "substantially" indicates that the lifting of both ends is simultaneous and in unison within operational parameters.) In exemplary applications the upper surface 160 of support 50a is level prior to the lifting and remains level during the lifting. The lifting of support 50a releases separated circuit packages 14 from pins 60. After such release, support 50a can be, for example, manually lifted from pins 108 and 110, and the separated packages removed from support 50a.

In compliance with the statute, the invention has been described in language more or less specific as to structural and methodical features. It is to be understood, however, that the invention is not limited to the specific features shown and described, since the means herein disclosed comprise preferred forms of putting the invention into effect. The invention is, therefore, claimed in any of its forms or modifications within the proper scope of the appended claims appropriately interpreted in accordance with the doctrine of equivalents.

CLAIMS:

1. An integrated circuit package separator for separating integrated circuit packages from a board comprising a plurality of integrated circuits bonded thereto, the board having a plurality of holes extending within it, the separator comprising:

a base having a plurality of pins extending upwardly therefrom;

a support over the base and having an upper surface, the support having a plurality of holes extending therethrough, the pins extending through the holes and upwardly beyond the upper surface of the support; the support and pins being configured such that the pins extend into the holes in the board when the board is placed over the support upper surface;

an actuator beneath the support and configured to vertically displace the support and lift the support off the pins; and

a cutting mechanism configured to cut the board while the board is over the support upper surface and thereby separate the integrated circuit packages from one another.

2. The separator of claim 1 wherein the pins align with the board such that each of the separated integrated circuit packages is retained to the support by at least one pin.

3. The separator of claim 1 wherein the pins align with the board such that each of the separated integrated circuit packages is retained to the support by at least two pins.

4. The separator of claim 1 wherein the support is a sheet comprising aluminum and having a thickness of at least 3/16 inches.

5. The separator of claim 1 wherein the actuator is pneumatically powered.

6. The separator of claim 1 wherein the actuator is coupled to the support through a lift member, the lift member having a substantially planar upper surface and the base having a substantially planar upper surface, the lift member substantially planar upper surface being substantially flush with the base substantially planar upper surface.

7. The separator of claim 1 wherein the actuator is coupled to the support through a lift member, the lift member having at least one post extending upwardly therefrom, the at least one post extending through a hole in the support.

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8. The separator of claim 1 wherein the actuator is coupled to the support through a lift member, the lift member having at least two posts extending upwardly therefrom, the at least two posts extending through holes in the support and aligning the support relative to the lift member.

9. The separator of claim 1 wherein the actuator is pneumatically powered; the actuator comprising a pair of gas ports, one of the ports being a gas inlet when the actuator lifts the support and the other port being a gas outlet when the actuator lifts the support; the separator further comprising at least one pressure release valve in fluid communication with the gas outlet.

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10. An integrated circuit package separator for separating integrated circuit packages from a board comprising a plurality of integrated circuits bonded thereto, the board having a plurality of holes extending within it, the separator comprising:

a base having a plurality of pins extending upwardly therefrom;

a support over the base and having an planar surface, the support having a plurality of holes extending therethrough and a pair of opposing ends, the pins extending through the holes and upwardly beyond the upper surface of the support; the support and pins being configured such that the pins extend into the holes in the board when the board is placed over the support upper surface;

a pair of actuators beneath the support and configured to vertically displace the support and lift the support off the pins; and

a cutting mechanism configured to cut the board while the board is over the support planar surface and thereby separate the integrated circuit packages from one another.

11. The separator of claim 10 wherein the pins align with the board such that each of the separated integrated circuit packages is retained to the support by at least one pin.

12. The separator of claim 10 wherein the pins align with the board such that each of the separated integrated circuit packages is retained to the support by at least two pins.

13. The separator of claim 10 wherein the actuators are pneumatically powered.

14. The separator of claim 10 wherein the actuators are coupled to the support through first and second lift members, respectively; the lift members having substantially planar upper surfaces and the base having a substantially planar upper surface, the substantially planar upper surfaces of the lift members being substantially flush with the base substantially planar upper surface.

15. The separator of claim 10 wherein the actuators are coupled to the support through first and second lift members, respectively; at least one of the lift members having at least one post extending upwardly therefrom, the at least one post extending through a hole in the support.

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16. The separator of claim 10 wherein the actuators are coupled to the support through first and second lift members, respectively; the first and second lift members each having at least one post extending upwardly therefrom, the posts extending through holes in the support.

17. The separator of claim 10 wherein the actuators are coupled to the support through first and second lift members, respectively; the first and second lift members each having at least two posts extending upwardly therefrom, the posts extending through holes in the support.

18. The separator of claim 17 wherein the posts are tapered, the tapered posts being wider at the base than above the base.

19. The separator of claim 10 wherein the actuators are pneumatically powered; the actuators each comprising a pair of gas ports, one of each pair of ports being a gas inlet when the actuator lifts the support and the other port of each pair of ports being a gas outlet when the actuator lifts the support; the separator further comprising at least one pressure release valve in fluid communication with the gas outlets.

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20. The separator of claim 10 wherein the actuators are pneumatically powered; the actuators each comprising a pair of gas ports, one of each pair of ports being a gas inlet when the actuator lifts the support and the other port of each pair of ports being a gas outlet when the actuator lifts the support; the separator further comprising at least two pressure release valves, one of the pressure release valves being in fluid communication with one of the gas outlets, and an other of the pressure release valves being in fluid communication with the other of the gas outlets.

21. The separator of claim 10 wherein the actuators comprise a first actuator proximate one of said opposing ends and a second actuator proximate the other of said opposing ends.

PAT-US\AP-RED

22. An integrated circuit package separator for separating a plurality of integrated circuit packages from one another, the integrated circuit packages being provided as integrated circuit chip components joined to a board, the separating including cutting the board, the separator comprising:

a panel;

a plurality of blocks over the panel, the blocks having upper surfaces and being configured to support the board while leaving the integrated circuit chip components extending between the block upper surfaces and the panel; and

a cutting mechanism configured to cut the board while the board is supported on the blocks and to thereby separate the integrated circuit packages from one another.

23. The separator of claim 22 wherein the panel is fastened to the support.

24. The separator of claim 22 wherein components have a thickness and the blocks have a thickness about equal to that of the components.

25. The separator of claim 22 wherein at least some of the components have a common thickness and the blocks have a thickness about equal to said common thickness.

26. The separator of claim 22 wherein the blocks are in a one-to-one correspondence with the integrated circuit packages on the board.

27. The separator of claim 22 comprising more than one panel over the support, each panel having blocks associated therewith.

28. The separator of claim 27 wherein the each of the panels and blocks associated therewith is a panel and block assembly, the panel and block assemblies all being identical to one another.

29. The separator of claim 22 wherein the blocks are fastened to the panel.

30. The separator of claim 22 wherein the blocks are one-piece with the panel.

31. The separator of claim 22 further comprising pins extending upwardly from beneath the panel to beyond an upper surface of the panel, the pins configured to extend into the board and retain the board over the panel.

32. The separator of claim 31 wherein the pins do not extend through the panel.

33. The separator of claim 31 further comprising an actuator beneath the panel and configured to vertically displace the panel.

34. The separator of claim 33 wherein the actuator is pneumatically powered.

35. An integrated circuit package separator for separating integrated circuit packages from a board comprising a plurality of integrated circuit components bonded thereto, the components extending outwardly from the board, the board having a plurality of holes extending within it, the separator comprising:

a base having a plurality of pins extending upwardly therefrom;

a support over the base and having an upper planar surface, the support having a plurality of holes extending therethrough and a pair of opposing ends, the pins extending through the holes and upwardly beyond the upper planar surface of the support; the support and pins being configured such that the pins extend into the holes in the board when the board is placed over the support upper planar surface;

a pair of actuators beneath the support and configured to vertically displace the support and lift the support off the pins, the actuators comprising a first actuator proximate one of said opposing ends and a second actuator proximate the other of said opposing ends;

a panel over the support;

a plurality of blocks over the panel, the blocks having upper surfaces and being configured to support the board while leaving the integrated circuit chip components extending between the block upper surfaces and the panel; and

a cutting mechanism configured to cut the board while the board is over the panel and to thereby separate the integrated circuit packages from one another.

36. The separator of claim 35 wherein the pins align with the board such that each of the separated integrated circuit packages is retained to the support by at least one pin.

37. The separator of claim 35 wherein the pins align with the board such that each of the separated integrated circuit packages is retained to the support by at least two pins.

38. The separator of claim 35 wherein the actuators are pneumatically powered.

39. The separator of claim 35 wherein the actuators are coupled to the support through first and second lift members, respectively; the lift members having substantially planar upper surfaces and the base having a substantially planar upper surface, the substantially planar upper surfaces of the lift members being substantially flush with the base substantially planar upper surface.

40. The separator of claim 35 wherein the actuators are coupled to the support through first and second lift members, respectively; at least one of the lift members having at least one post extending upwardly therefrom, the at least one post extending through a hole in the support.

41. The separator of claim 35 wherein the actuators are coupled to the support through first and second lift members, respectively; the first and second lift members each having at least two posts extending upwardly therefrom, the posts extending through holes in the support.

42. The separator of claim 41 wherein the posts are tapered, the tapered posts being wider at the base than above the base.

43. The separator of claim 35 wherein the actuators are pneumatically powered; the actuators each comprising a pair of gas ports, one of each pair of ports being a gas inlet when the actuator lifts the support and the other port of each pair of ports being a gas outlet when the actuator lifts the support; the separator further comprising at least one pressure release valve in fluid communication with the gas outlets.

44. The separator of claim 35 wherein the actuators are pneumatically powered; the actuators each comprising a pair of gas ports, one of each pair of ports being a gas inlet when the actuator lifts the support and the other port of each pair of ports being a gas outlet when the actuator lifts the support; the separator further comprising at least two pressure release valves, one of the pressure release valves being in fluid communication with one of the gas outlets, and an other of the pressure release valves being in fluid communication with the other of the gas outlets.

45. The separator of claim 35 wherein the actuators comprise a first actuator proximate one of said opposing ends and a second actuator proximate the other of said opposing ends.

46. The separator of claim 35 wherein the panel is fastened to the support.

47. The separator of claim 35 wherein the blocks are in a one-to-one correspondence with the integrated circuit packages on the board.

48. The separator of claim 35 comprising more than one panel over the support, each panel having blocks associated therewith.

49. The separator of claim 35 wherein the blocks are fastened to the panel.

50. The separator of claim 35 wherein the blocks are one-piece with the panel.

51. The separator of claim 35 wherein the pins do not extend through the panel.

52. A method of forming integrated circuit packages, comprising:

providing a panel over a support;

providing a plurality of blocks extending upwardly from the panel, the blocks having upper surfaces;

providing a board having a plurality of integrated circuit components bonded thereto, the integrated circuit components extending outwardly from the board and forming a plurality of integrated circuit packages across the board;

placing the board over the panel, the block upper surfaces supporting the board while leaving the integrated circuit components extending between the block upper surfaces and the panel;

while the board is over the panel, cutting the board to separate the integrated circuit packages from one another.

53. The method of claim 52 wherein the providing the panel over the support comprises fastening the panel to the support.

54. The method of claim 52 wherein the blocks are provided in a one-to-one correspondence with the integrated circuit packages.

55. The method of claim 52 comprising providing more than one panel over the support, each panel having blocks associated therewith.

56. The method of claim 55 wherein the providing a board comprises providing separate boards over the separate panels.

57. The method of claim 55 wherein the each of the panels and blocks associated therewith is a panel and block assembly, the panel and block assemblies all being identical to one another.

58. The method of claim 52 wherein the providing the blocks comprises fastening the blocks to the panel.

59. The method of claim 52 wherein the blocks are one-piece with the panel.

60. The method of claim 52 further comprising providing pins extending upwardly from beneath the panel to beyond an upper surface of the panel, the pins extending into the board to retain the board over the panel.

61. The method of claim 60 wherein the pins do not extend through the panel.

62. The method of claim 52 further comprising:

providing an actuator beneath the panel; and

after the cutting, vertically displacing the panel by the actuator.

63. The method of claim 52 further comprising:

providing pins extending upwardly from beneath the panel to beyond an upper surface of the panel, the pins extending into the board to retain the board over the panel;

providing an actuator beneath the panel; and

after the cutting, vertically displacing the panel by the actuator to release the cut board from the pins.

64. The method of claim 52 further comprising:

providing pins extending upwardly from beneath the panel to beyond an upper surface of the panel, the pins extending into the board to retain the board over the panel, the pins and board aligning such that each of the separated integrated circuit packages is retained to the support by at least one pin;

providing an actuator beneath the panel; and

after the cutting, vertically displacing the panel by the actuator to release the separated integrated circuit packages from the pins.

65. A method of forming integrated circuit packages, comprising:

providing a base having a plurality of pins extending upwardly therefrom;

providing a support over the base, the support having an upper surface and a plurality of holes extending therethrough, the pins extending through the holes and upwardly beyond the upper surface of the support;

providing an actuator beneath the support;

providing a board having a plurality of integrated circuits bonded thereto, the integrated circuits forming a plurality of integrated circuit packages across the board, the board having a plurality of holes extending therethrough;

placing the board over the support upper surface, the pins extending into the holes in the board;

while the board is over the support upper surface, cutting the board to separate the integrated circuit packages from one another; and

after the cutting, displacing the support by the actuator to lift the support and cut board off the pins.

66. The method of claim 65 further comprising, after the displacing, removing the separated integrated circuit packages from over the support.

67. The method of claim 65 wherein the pins and board align such that each of the separated integrated circuit packages is retained to the support by at least one pin, the displacing releasing the separated integrated circuit packages from the pins.

68. The method of claim 65 wherein the pins and board align such that each of the separated integrated circuit packages is retained to the support by at least two pins, the displacing releasing the separated integrated circuit packages from the pins.

69. The method of claim 65 wherein the pins and board align such that each of the separated integrated circuit packages is retained to the support by at least one pin, the displacing releasing the separated integrated circuit packages from the pins; the method further comprising, after the displacing, removing the separated integrated circuit packages from over the support.

70. The method of claim 65 wherein the actuator is pneumatically powered and the displacing the support comprises forcing gas into the actuator.

71. A method of forming integrated circuit packages, comprising:

providing a base having a plurality of pins extending upwardly therefrom;

providing a support over the base, the support having an upper planar surface and a pair of opposing ends, the support having a plurality of holes extending therethrough, the holes aligning with the pins, the pins extending through the holes and upwardly beyond the upper planar surface of the support;

providing a pair of actuators beneath the support, a first of the actuators being proximate one of the opposing ends and an other of the actuators being proximate the other of the opposing ends;

providing a board having a plurality of integrated circuits bonded thereto, the integrated circuits forming a repeating pattern of integrated circuit packages across the board, the board having a plurality of holes extending therethrough;

placing the board over the support upper planar surface, the pins extending into the holes in the board;

while the board is over the support upper planar surface, cutting the board to separate the integrated circuit packages from one another; and

after the cutting, vertically displacing the support by the actuators to lift the support off the pins, the vertically displacing comprising lifting both ends of the support substantially simultaneously and substantially in

unison, the support upper planar surface remaining substantially level as the support is lifted off the pins by the actuators.

72. The method of claim 71 wherein the actuators are pneumatically powered and the vertically displacing the support comprises forcing gas into the actuators.

73. The method of claim 71 wherein the actuators are pneumatically powered and the vertically displacing the support comprises forcing gas into the actuators; the substantially simultaneously and substantially in unison lifting of the ends of the support comprising forcing the gas into the individual actuators substantially simultaneously, and maintaining a substantially equal gas pressure at both actuators during the lifting.

74. The method of claim 71 wherein the actuators are pneumatically powered and the vertically displacing the support comprises forcing gas into the actuators; the forcing gas comprises flowing gas into the actuators through inlet lines and out of the actuators through outlet lines; and the method further comprising equilibrating gas in the outlet lines with ambient pressure during the lifting.

75. The method of claim 71 wherein:

the actuators are pneumatically powered and the vertically displacing the support comprises forcing gas into the actuators;

the forcing gas comprises flowing gas into the actuators through inlet lines and out of the actuators through outlet lines;

the substantially simultaneously and substantially in unison lifting of the ends of the support comprising forcing the gas into the individual actuators substantially simultaneously, and maintaining a substantially equal gas pressure at both actuators during the lifting; and

the maintaining a substantially equal gas pressure comprises equilibrating gas in the outlet lines with ambient pressure during the lifting.

76. The method of claim 71 further comprising, after the vertically displacing, removing the separated integrated circuit packages from over the support.

77. The method of claim 71 wherein the pins and board align such that each of the separated integrated circuit packages is retained to the support by at least one pin, the vertically displacing releasing the separated integrated circuit packages from the pins.

78. A method of forming integrated circuit packages, comprising:

providing a base having a plurality of pins extending upwardly therefrom;

providing a support over the base, the support having an upper planar surface and a pair of opposing ends, the support having a plurality of holes extending therethrough, the holes aligning with the pins, the pins extending through the holes and upwardly beyond the upper planar surface of the support;

providing a pair of actuators beneath the support, a first of the actuators being proximate one of the opposing ends and an other of the actuators being proximate the other of the opposing ends;

providing at least one panel over the support, the panel having a plurality of blocks extending upwardly therefrom, the blocks having upper surfaces;

providing a board having a plurality of integrated circuit components bonded thereto, the integrated circuit components extending outwardly from the board and forming a repeating pattern of integrated circuit packages across the board, the board having a plurality of holes extending therethrough;

placing the board over the panel, the pins extending into the holes in the board, the block upper surfaces supporting the board while leaving the integrated circuit components extending between the block upper surfaces and the panel;

while the board is over the panel, cutting the board to separate the integrated circuit packages from one another; and

after the cutting, vertically displacing the support by the actuators to lift the support off the pins, the vertically displacing comprising lifting both ends of the support substantially simultaneously and substantially in unison, the support upper planar surface remaining substantially level as the support is lifted off the pins by the actuators.

79. The method of claim 78 wherein the actuators are pneumatically powered and the vertically displacing the support comprises forcing gas into the actuators.

80. The method of claim 78 wherein the actuators are pneumatically powered and the vertically displacing the support comprises forcing gas into the actuators; the substantially simultaneously and substantially in unison lifting of the ends of the support comprising forcing the gas into the individual actuators substantially simultaneously, and maintaining a substantially equal gas pressure at both actuators during the lifting.

81. The method of claim 78 wherein the actuators are pneumatically powered and the vertically displacing the support comprises forcing gas into the actuators; the forcing gas comprises flowing gas into the actuators through inlet lines and out of the actuators through outlet lines; and the method further comprising equilibrating gas in the outlet lines with ambient pressure during the lifting.

82. The method of claim 78 further comprising, after the vertically displacing, removing the separated integrated circuit packages from over the support.

83. The method of claim 78 wherein the pins and board align such that each of the separated integrated circuit packages is retained to the support by at least one pin, the vertically displacing releasing the separated integrated circuit packages from the pins.

84. The method of claim 78 wherein the blocks are provided in a one-to-one correspondence with the integrated circuit packages.

85. The method of claim 78 wherein the providing the blocks comprises fastening the blocks to the panel.

86. The method of claim 78 wherein the blocks are one-piece with the panel.

87. The method of claim 78 wherein the pins do not extend through the panel.

88. The method of claim 78 comprising providing more than one panel over the support, each panel having blocks associated therewith.

89. The method of claim 88 wherein the providing a board comprises providing separate boards over the separate panels.

90. The method of claim 88 wherein the each of the panels and blocks associated therewith is a panel and block assembly, the panel and block assemblies all being identical to one another.

91. The method of claim 88 wherein the each of the panels and blocks associated therewith is a panel and block assembly, the panel and block assemblies all being identical to one another, and the blocks are provided in a one-to-one correspondence with the integrated circuit packages.

ABSTRACT OF THE DISCLOSURE

In one aspect, the invention includes a method of forming integrated circuit packages. A base having a plurality of pins extending upwardly therefrom is provided. A support is provided over the base. The support has an upper surface and a plurality of holes extending therethrough. The pins extend through the holes and upwardly beyond the upper surface of the support. An actuator is provided beneath the support. A board having a plurality of integrated circuits bonded thereto is provided. The integrated circuits form a repeating pattern of integrated circuit packages across the board, and the board has a plurality of holes extending through it. The board is placed over the support upper surface with the pins extending into the holes in the board. While the board is over the support upper surface, it is cut to separate the integrated circuit packages from one another. After the cutting, the support is vertically displaced by the actuator to lift the support off the pins.

In another aspect, the invention encompasses an integrated circuit package separator for separating integrated circuit packages from a board.

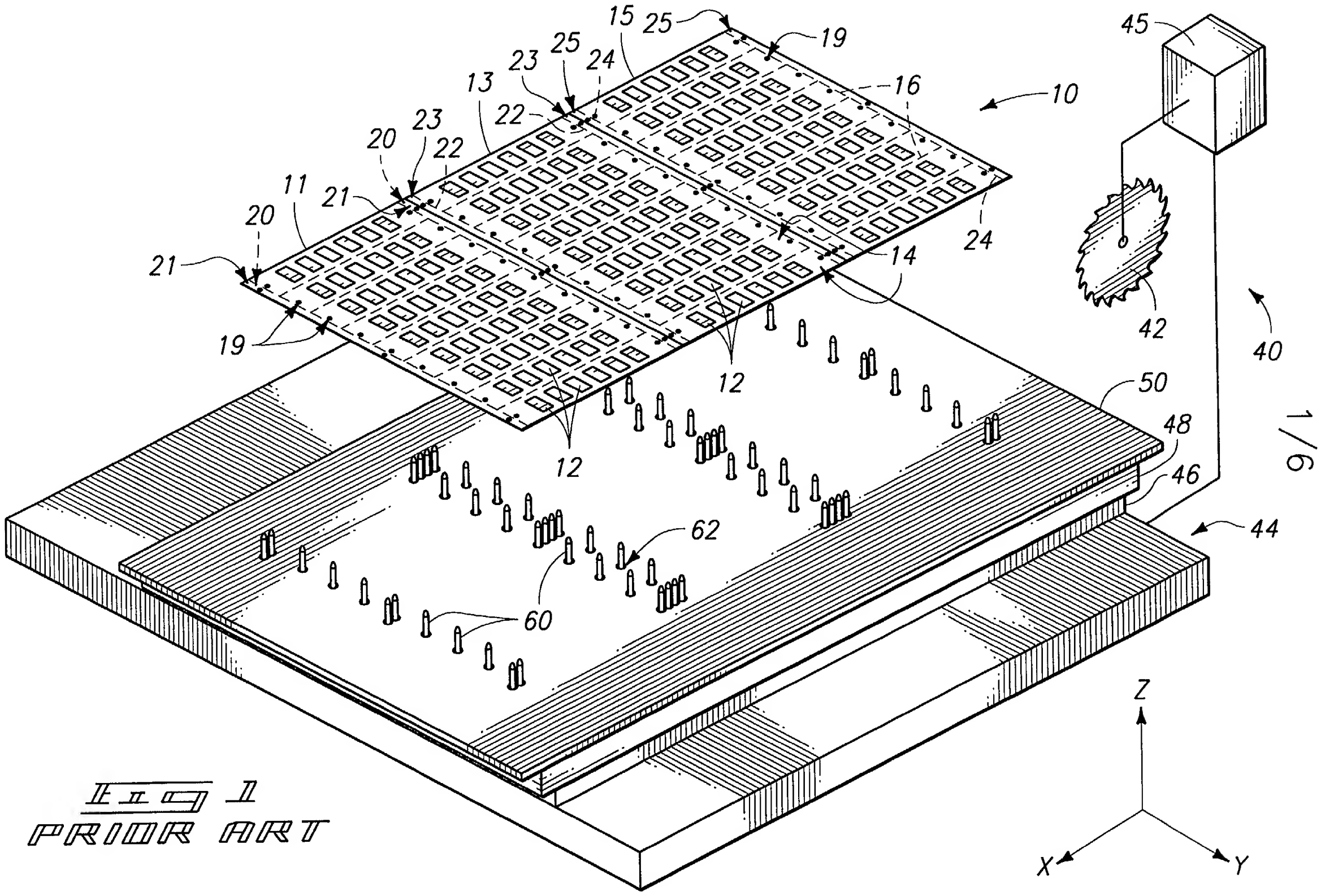

Fig 1
PRIOR ART

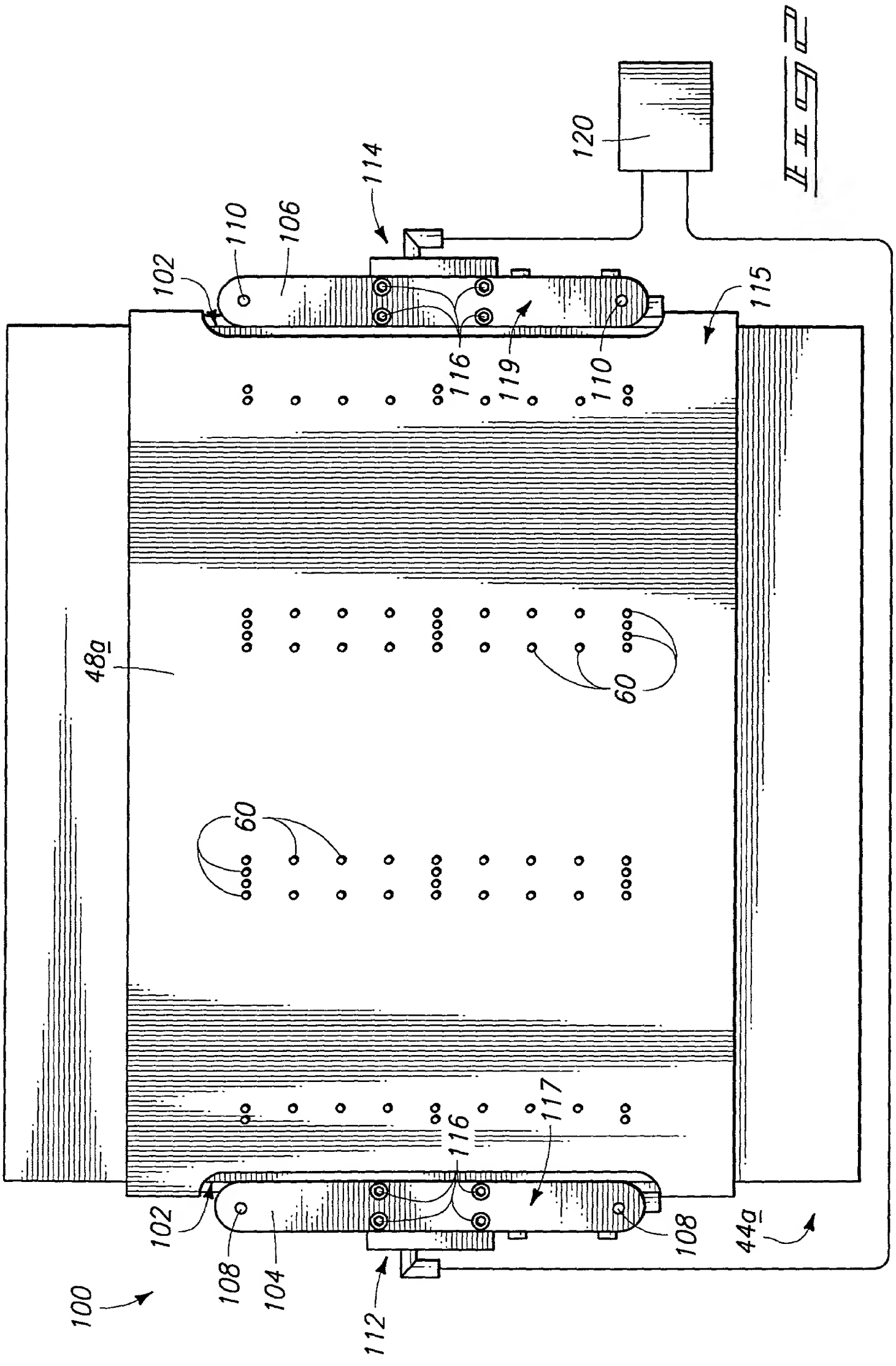
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Fig 2

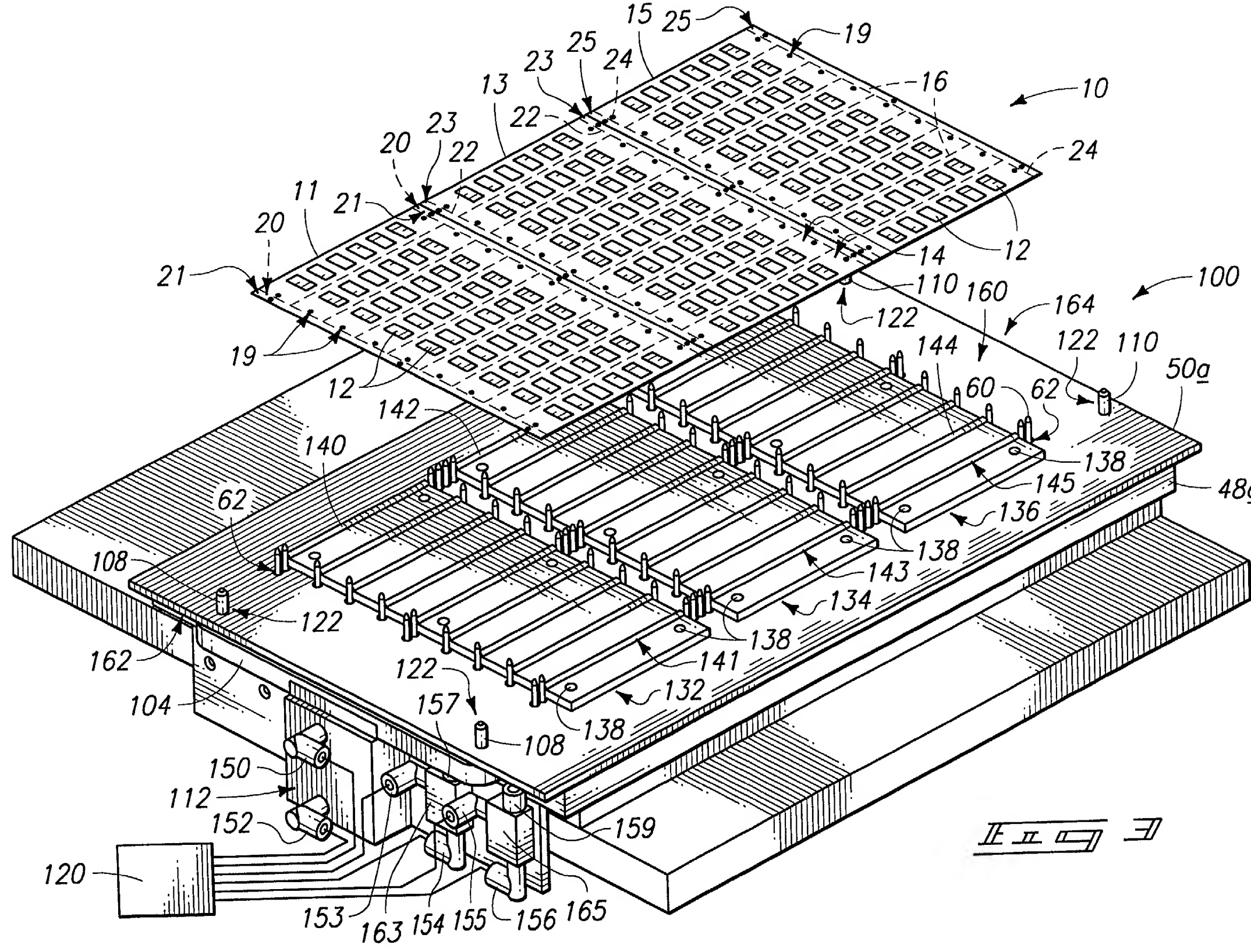
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Fig 3

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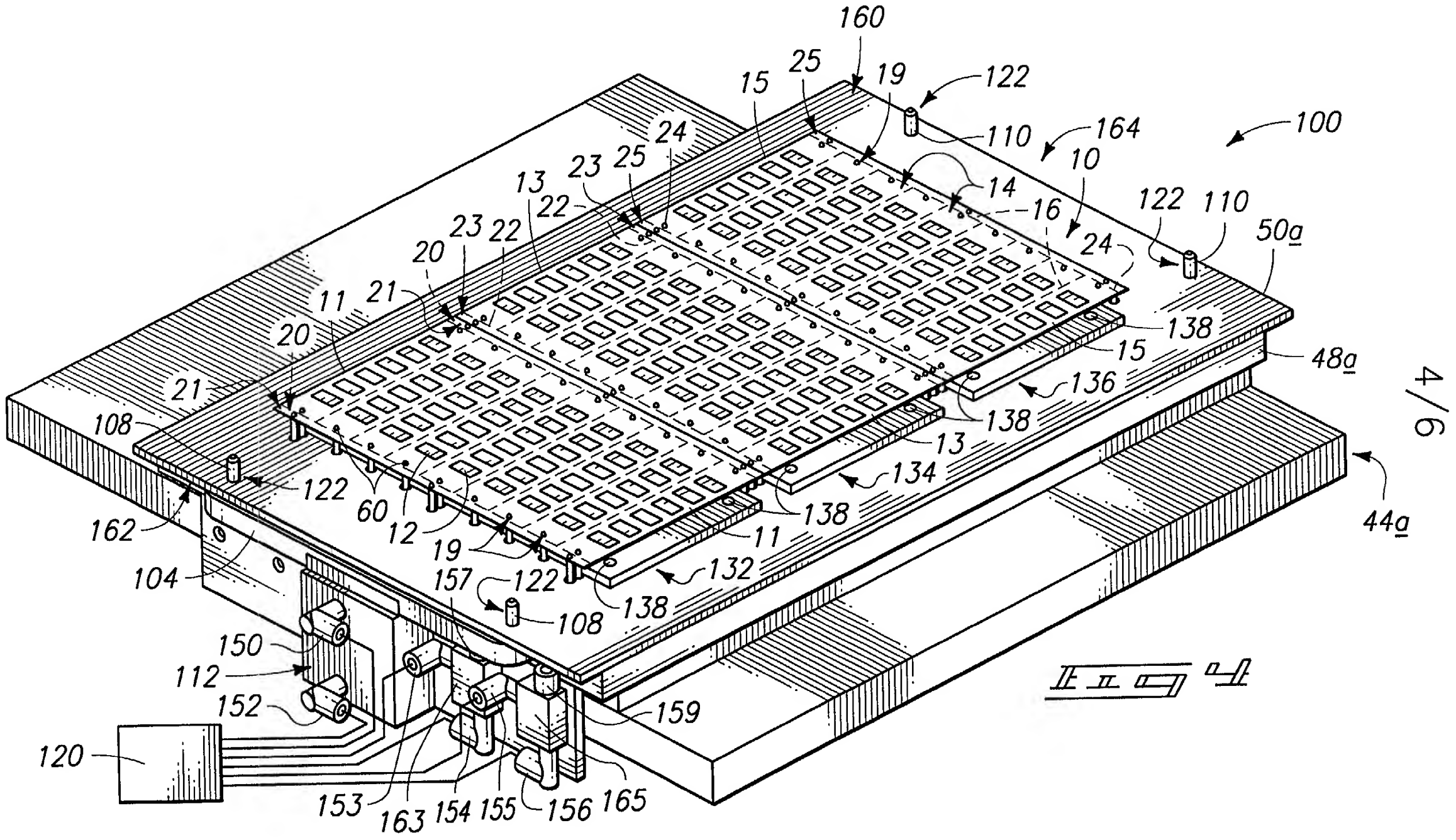

Fig 4

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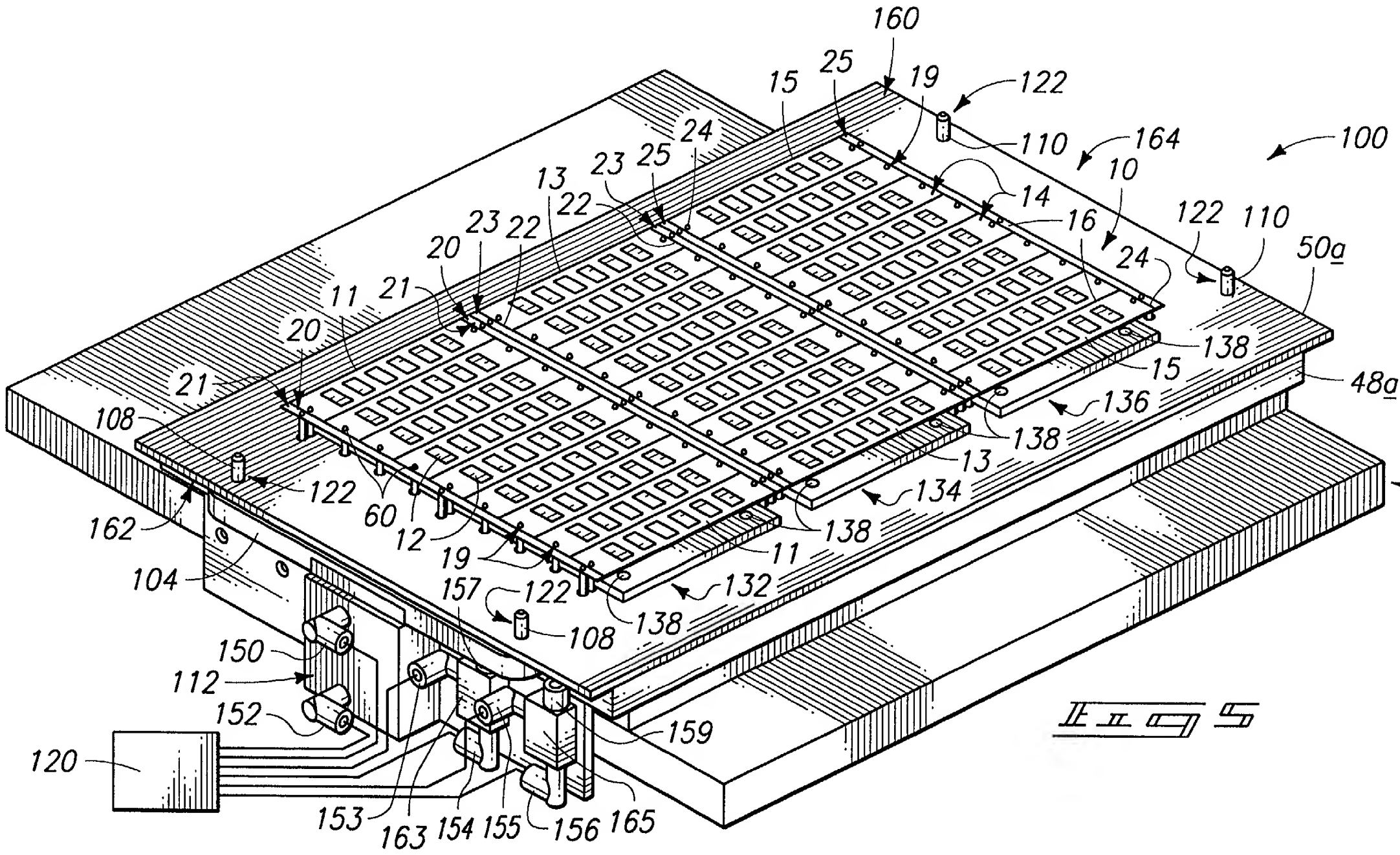

Fig 5

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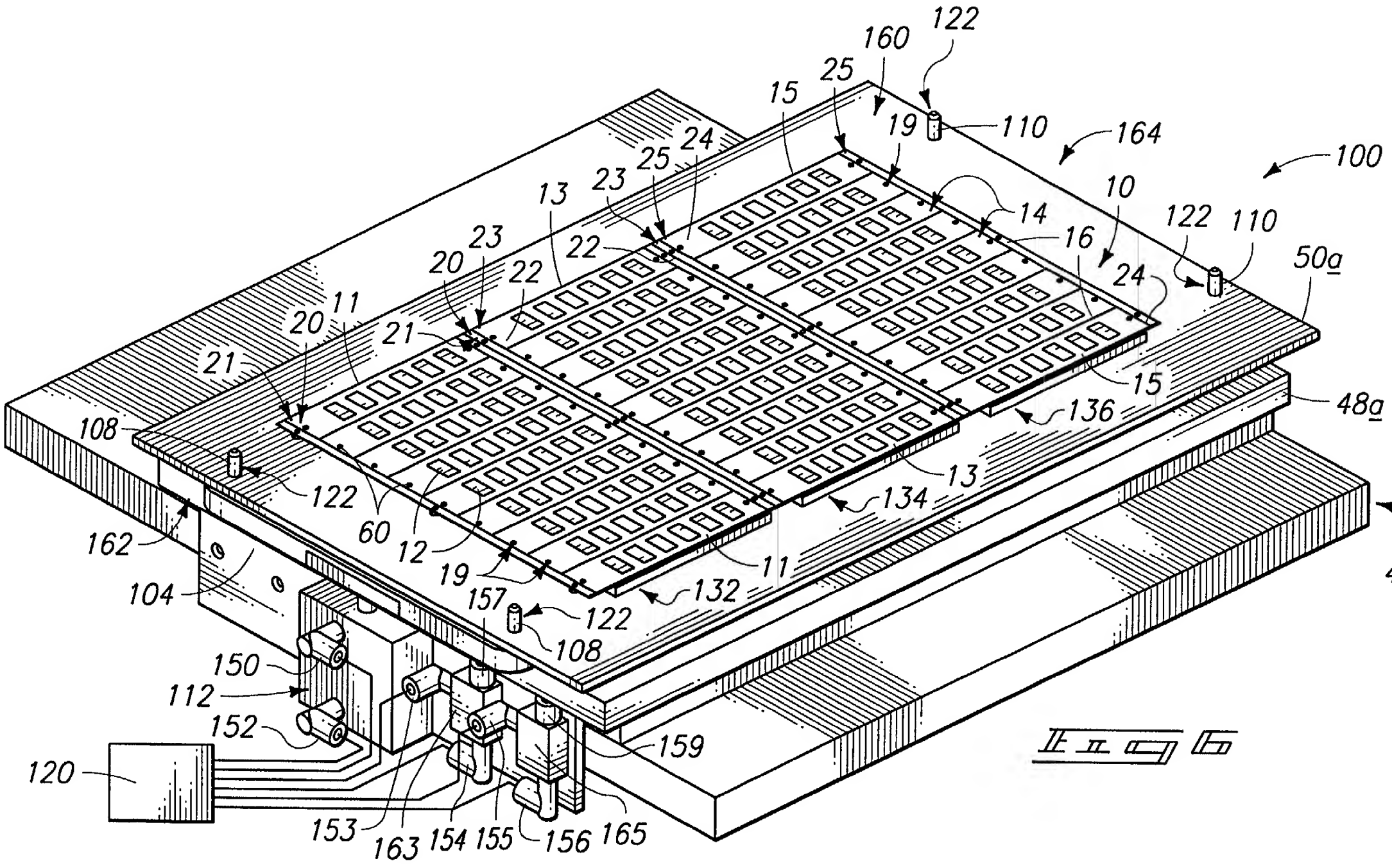


Fig 6

EL169869902

EL465688995
EL169835515

EXPRESS MAIL LABEL

DECLARATION OF SOLE INVENTOR FOR PATENT APPLICATION

As the below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled: Integrated Circuit Package Separators, And Methods Of Forming Integrated Circuit Packages, the specification of which is attached hereto.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims.

I acknowledge the duty to disclose information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations §1.56.

PRIOR FOREIGN APPLICATIONS:

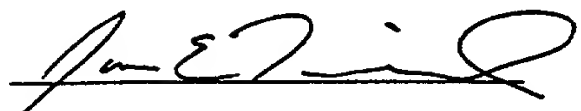
I hereby state that no applications for foreign patents or inventor's certificates have been filed prior to the date of execution of this declaration.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statement may jeopardize the validity of the application or any patent issued therefrom.

ATTORNEY DOCKET NO. MRG

* * * * * * * * * *

Full name of sole inventor: Jason E. Tripard

Inventor's Signature: 

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